Section: Radio Diagnosis

Original Research Article

DIAGNOSTIC PERFORMANCE OF ABBREVIATED BREAST MRI IN THE EVALUATION OF SUSPECTED BREAST LESIONS: A PROSPECTIVE COMPARATIVE STUDY WITH FULL-PROTOCOL MRI

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ABSTRACT

Background: Breast MRI is highly sensitive for the breast lesion detection but prolonged examination time and limited accessibility restricts its widespread use. Abbreviated breast MRI (AB-MRI) is a newly developed technique that has similar diagnostic utility but takes less time to scan. The objective of this study is to assess the value and utility of short breast MRI scan to diagnose patients with suspected breast lesions and to determine the sensitivity and specificity of breast MRI. **Materials and Methods:** This is a prospective study that consisted of 30 female patients who were presenting with breast lumps and/or suspected breast lesions. The breast MRI was performed in a 1.5 T MRI machine equipped with a dedicated breast coil and the whole breast was scanned. An abbreviated MRI protocol that included pre-contrast T1-weighted images, first post-contrast T1-weighted images, subtraction images and MIP images was studied. Imaging findings were evaluated based on the BI-RADS MRI criteria and compared with the complete MRI imaging findings and histopathological diagnosis (when available). Diagnostic Performance parameters were determined. **Result:** The mean age of patients was 42.93 ± 12.66 years. The diagnostic accuracy, positive predictive value (PPV), negative predictive value (NPV) and sensitivity of AB-MRI were 90%, 100% and 86.4% and 72.7%, respectively. The mean interpretation time was 3.10 ± 0.73 minutes with a mean acquisition time of 7.15 ± 1.50 minutes. The most prevalent histopathological diagnosis was fibroadenoma followed by invasive ductal carcinoma. **Conclusion:** Abbreviated breast MRI has been shown to yield accurate assessment of lesions while avoiding the long scan and report times of whole breast MRI; in certain clinical circumstances it could be a valid alternative to whole breast MRI.

INTRODUCTION

Breast cancer is one of the most prevalent cancers in female patients globally and early detection of breast cancer is a key determinant to enhance patient outcomes.[1] Breast magnetic resonance imaging (MRI) is seen as the most sensitive imaging test available for the detection and characterization of breast lesions, especially for women with a high risk, in patients with dense breast tissue and in those with unclear results by other imaging modalities. Breast MRI offers good soft tissue contrast resolution and also has the ability to assess the morphology, vascularity and enhancement kinetics of lesions, both of which are important in the accurate diagnosis and staging.[2,3]

While the conventional dynamic contrast-enhanced breast MRI (CE-MRI) has great diagnostic accuracy, its use is currently limited because the technique requires specialized expertise and is high cost, long acquisition time, and not widely available. The breast MRI exam takes multiple sequences and is a long examination, and so may not be appropriate as a screening tool, particularly in resource limited environments.[4,5]

In order to address these shortcomings, an abbreviated whole breast MRI (AB-MRI) protocol was developed, that provides the same diagnostic performance as full breast MRI but can limit the time devoted to an examination and improve patient access.[6,7] The main feature of AB-MRI is the reduced acquisition time and time to interpretation of the essential sequences that are accentuated for the

detection of lesions, typically consisting of pre- and post-contrast imaging at reduced acquisition and interpretation time. There are several studies indicating that AB-MRI may offer the same diagnostic value as traditional MRI, and have the same sensitivity for the detection of breast malignancies.[8,9]

Shorter scan duration, increased patient compliance and more efficient workflow as well as the opportunity to use MRI as part of a more comprehensive screening program are all potential gains of using AB-MRI.[10-13] Before a routine clinical use, however, there is a need for validation of its diagnostic performance in comparison to full MRI. To assess the validity and effectiveness of using AB-MRI to detect clinically important breast lesions, a comparison between the accuracy of AB-MRI and the conventional full MRI techniques for the purposes of sensitivity, specificity, and overall agreement is required.[14-16]

Breast MRI has been shown to be useful for breast lesion detection but the utility of a short protocol may be further explored in patients with suspected breast changes in various clinical and patient populations. A faster MRI protocol, that also yields similar diagnostic information, could be a good way of making the MRI more accessible, while also ensuring diagnostic confidence.[17,18]

Thus, the objective of this research is to evaluate the use of abbreviated breast MRI in patients when breast suspicious lesions are suspected and to see the diagnostic value of abbreviated breast MRI in relation to complete breast MRI. The research also will evaluate the sensitivity and specificity of the abbreviated MRI, and its reliability as a substitute imaging method for a traditional breast MRI.

MATERIALS AND METHODS

Study Design and population: This Prospective study was carried out in the Dept of Radiodiagnosis, NIMS, Jaipur during 18 months. Female patients on whom the examination was performed during the study had breast swelling/lumps or suspected breast lesions in the outpatient and In-patient Department. Sample size of at least 30 patients was used for complete enumeration sampling method. A convenient sampling technique was used to select patients. This study was carried out after institutional ethical approval and informed consent was obtained from the participants.

Patient Selection Criteria: Patients with clinically suspected breast lesions or palpable breast lump were included in the study. Patients were excluded if they had had previous radiotherapy or chemotherapy of the breast, breast implants, post-operative changes in the breast, male breast lesion, or if there were a contraindication to MRI such as the presence of any other non-MRI compatible implants or devices.

MRI Acquisition and Abbreviated MRI Protocol: The breast MRI examinations were carried out on a 1.5T MRI with a specific bilateral breast coil. A gadolinium based contrast agent was used in a dose of 0.1 mmol/kg body weight intravenously.

The AB-MRI protocol consisted of the most important sequences of the full breast MRI procedures, namely sequences useful for lesion detection and characterization.

- 3D Axial T1 weighted pre-contrast imaging studies.
- First post-contrast axial T1-weighted sequence
- Images obtained by subtracting one from the other and maximum intensity projection (MIP) images

The abbreviated MRI findings were compared with the full protocol MRI or/and histopathologic exam used as the reference standard. Lesion assessment was done based on the ACR classification system for Breast Imaging Reporting and Data System (BI-RADS) 2013.

Image analysis and statistical evaluation: Lesion characteristics evaluated by MRI were studied such as location, morphology, enhancement pattern and BI-RADS category. The MR diagnostic utility of abbreviated MRI was compared with complete MRI indications or as possible with histopathological diagnosis, where available.

The data were analysed using SPSS software v29 and Microsoft Excel. The collected data were analysed using appropriate statistical tests. Continuous variables were expressed as mean ± standard deviation and compared using the independent Student's t-test or an appropriate non-parametric test. Categorical data were presented as numbers and percentages and analyzed by the Chi-Square test or Fisher's exact test. Various diagnostic parameters such as sensitivity, specificity and accuracy in abbreviated MRI were computed.

RESULTS

Thirty female patients having clinically suggested breast lesions were included in the study. The average age of the study participants was 42.93 ± 12.66 years. Typical MRI and abbreviated MRI imaging findings were analysed and compared with pathological diagnosis, if available. The diagnostic value of shortened MRI was compared to full MRI.

Demographic and clinical features of the cases are summarized in [Table 1 and Figure 1]. Most patients were in the 51-60 years age group and in this group left sided breast lesions were more common. Breast lumps most frequently involved were in the upper outer quadrant.

[Table 2] shows the MRI features of lesions seen on the typical and abbreviated MRI protocols. The majority of lesions had hypointense signal on pre-contrast T1 weighted sequences and variable signal and post-contrast enhancement patterns of T2. Post-contrast enhancement showed the most common enhancement pattern to be rapid heterogeneous enhancement.

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The BI-RADS distribution on standard and abbreviated MRI and histological correlation are shown in [Table 3]. The incidence of BI-RADS 4 and 5 lesions was higher on the standard-MRI scans, while the number of BI-RADS 2 and 3 lesions was higher on the abbreviated MRI scans. The most common benign diagnosis was fibroadenoma, and invasive ductal carcinoma was the most common malignant diagnosis.

[Table 4 and Figure 2] show the diagnostic comparison of the standard MRI with abbreviated MRI. Abbreviated MRI had high specificity (100 %), a diagnostic accuracy of 90 % and was in good agreement with the standard MRI, with acquisition and interpretation times being much shorter.

The diagnostic capabilities of abbreviated MRI and the associated time savings are shown in Figure 3. The reduced protocol was found to accurately assess the lesions, and also to shorten scanning and reporting time, and may therefore be used as a quick alternative to breast MRI, and be a valuable option where longer conventional breast MRI is used.

Table 1: Demographic and Clinical Characteristics of Study Population

Parameter	Category	Frequency (n)	Percentage (%)
Age group (years)	20–30	6	20.0
	31–40	8	26.7
	41–50	6	20.0
	51–60	10	33.3
Mean age		42.93 ± 12.66 years	
Laterality	Left breast	17	56.7
	Right breast	13	43.3
Location of lump	Upper outer quadrant	10	33.3
	Upper inner quadrant	6	20.0
	Central/retroareolar	5	16.7
	Lower inner quadrant	5	16.7
	Lower outer quadrant	4	13.3

Table 2: MRI Findings on Standard and Abbreviated MRI Protocols

MRI Parameter	Category	Standard MRI n (%)	Abbreviated MRI n (%)
DWI findings	Diffusion restriction	14 (46.7)	—
	Mild/slight restriction	3 (10.0)	—
	No restriction	13 (43.3)	—
T2W signal intensity	Hyperintense	14 (46.7)	13 (43.3)
	Hypointense	15 (50.0)	13 (43.3)
	Isointense	1 (3.3)	4 (13.3)
Pre-contrast T1W FS signal	Hypointense	25 (83.3)	25 (83.3)
	Isointense	5 (16.7)	5 (16.7)
Post-contrast enhancement	Rapid heterogeneous/intense enhancement	10 (33.3)	10 (33.3)
	Moderate enhancement	—	4 (13.3)
	Mild/gradual enhancement	5 (16.7)	6 (20.0)
	Slow enhancement	9 (30.0)	2 (6.7)
	No enhancement	6 (20.0)	8 (26.7)

Table 3: BI-RADS Classification, Histopathological Correlation and Diagnostic Performance

Parameter	Category	Frequency (n)	Percentage (%)
Standard MRI BI-RADS	BI-RADS 2	9	30.0
	BI-RADS 3	6	20.0
	BI-RADS 4	9	30.0
	BI-RADS 5	6	20.0
Abbreviated MRI BI-RADS	BI-RADS 2	10	33.3
	BI-RADS 3	12	40.0
	BI-RADS 4	7	23.3
	BI-RADS 5	1	3.3
Histopathological diagnosis	Fibroadenoma	10	33.3
	IDC	7	23.3
	Cyst	6	20.0
	Duct ectasia	3	10.0
	LCIS	2	6.7
	DCIS	2	6.7

Table 4: Comparison of Abbreviated MRI with Standard MRI and Final Diagnosis

Diagnostic Parameter	Standard MRI	Abbreviated MRI
True Positive	—	8
True Negative	—	19
False Positive	—	0
False Negative	—	3
Sensitivity (%)	100	72.7
Specificity (%)	100	100
Positive Predictive Value (%)	100	100

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Negative Predictive Value (%)	100	86.4
Diagnostic Accuracy (%)	100	90.0
Mean acquisition time (min)	—	7.15 ± 1.50
Mean interpretation time (min)	—	3.10 ± 0.73
Mean lesion size (cm)	—	1.77 ± 1.01
Mean ADC value	—	1.21 ± 0.33

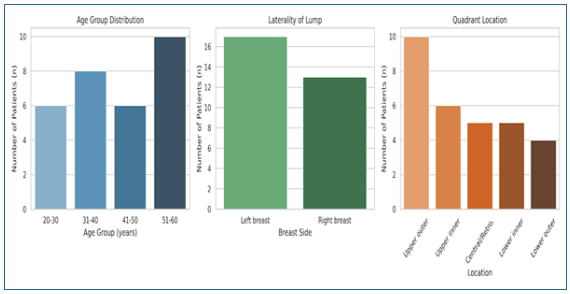

Figure 1: Age and Clinical Distribution of Patients

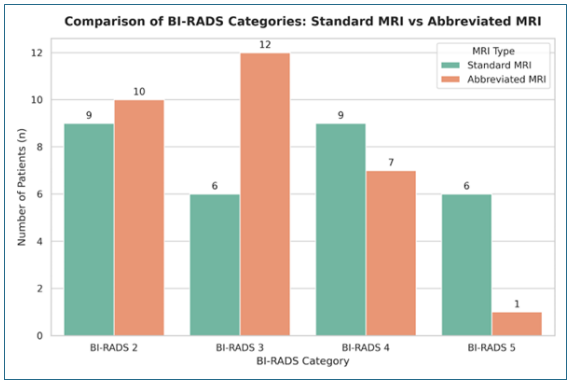

Figure 2: Comparison of BI-RADS Classification Between Standard MRI and Abbreviated MRI

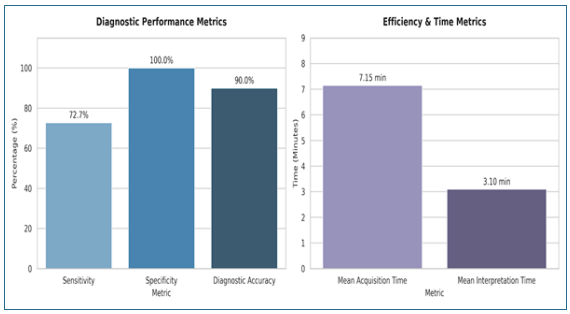

Figure 3: Diagnostic Performance and Time Efficiency of Abbreviated MRI

DISCUSSION

Breast MRI is the most powerful imaging modality to detect and characterise breast lesions, but it remains underutilized in the real clinical environment due to its increased acquisition time, higher cost, and limited availability. Abbreviated breast MRI (AB-MRI) is a new technique that may be promising because of its short exam and interpretation time and similar performance to full-protocol MRI. In patients with suspicious breast lesions, the present study found high specificity, good diagnostic accuracy, and speeded acquisition and interpretation time with AB-MRI to be useful as a diagnostic tool.

A sensitivity of 72.7% achieved with AB-MRI compared to full MRI and final diagnosis, and a specificity of 100%, with a diagnostic accuracy of 90%, were observed in the present study. This is because few patients were included in our study and we may not have had a screening population due to the heterogenous nature of breast lesions. Baxter et al demonstrated similar diagnostic performance of abbreviated and full MRI protocols in a meta-analysis; they have shown that AB-MRI can achieve high diagnostic accuracy with a shortened examination time.[4] Likewise, for breast cancer diagnosis, Pesapane et al reported in their systematic review and meta-analysis that short MRI is accurate in identifying breast cancer with performance similar to the long one, highlighting its potential breast imaging application.[17]

The decrease in MRI acquisition time and MRI interpretation time are among the significant benefits of AB-MRI. The mean acquisition time in our study was 7.15 ± 1.50 minutes and the interpretation time 3.10 ± 0.73 minutes. The results of this study further confirm the previous studies which showed that different short protocols may substantially reduce the workflow time without reducing the diagnostic level of confidence. Hernandez et al. had also pointed out that the reduced scanning time of AB-MRI injections is beneficial to the detection of breast cancer without compromising sensitivity,[1] and Heacock et al. reiterated the short imaging time of AB-MRI as an effective approach towards making MRI more accessible and usable in the field of breast cancer imaging.[2]

The present study revealed good correlation between abbreviated and standard MRI in the assessment of the lesion using the BI-RADS classification. On regular MRI, most of the lesions diagnosed as malignant (BI-RADS 4, 5) were identified; abbreviated MRI produced similar results for identifying a suspicious lesion. In the study by Wahab et al., they have evaluated the common types of breast MRI abnormalities and concluded that there was no significant difference in the characterization of lesions between AB-MRI and full MRI protocols, thus, AB-MRI can be relied upon for the assessment of lesions.[7] The authors found that using shortened MRI protocols with the proper sequences yielded comparable performance for diagnosis than classic MRI.[14]

Histopathologic correlation in our study revealed that fibroadenoma was most common benign lesion while the most common malignant diagnosis was invasive ductal carcinoma. In addition, previous screening studies have also shown that AB-MRI is clinically useful for detecting breast malignancies from various risk groups. Outcomes from abbreviated MRI screening have been favorable for cancer detection at

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3 years as reported by Kwon et al,[8] who reported high cancer detection capability, supporting MRI screening as a 3-year screening tool. Kim et al. also showed that abbreviated MRI was effective in maintaining the diagnosis as compared with complete MRI in women with a prior history of breast cancer.[9] Conventional MRI screening has proven cost- and time-prohibitive and patient-compliant in certain populations and the potential role of AB-MRI in these populations is particularly relevant. Abbreviated MRI is a potential screening option, especially for women with dense breasts, could also be a viable option, the FAST MRI study group reported.[3] Moreover, the diagnostic results of abbreviated MRI (AB-MRI) and DBT were examined in dense breasts and found to be comparable, towards which AB-MRI might present a promising alternative imaging approach for specific patient groups.[18]

New developments have made abbreviated MRI beyond the screening realm, such as in determining treatment responses and tailoring imaging approaches. In support, Tang and Hayward extended their findings to show that the shortened MRI could be usefully applied for response assessment following neoadjuvant chemotherapy thus highlighting its potential application in the management of BC.[13] Kuhl pointed out that AB-MRI has beyond just been a research idea, it is now an accepted imaging method that can be useful in a number of clinical settings.[16]

The results of the present investigation suggest that abbreviated MRI is feasible; however, careful selection of the patient and uniform interpretation criteria are critical. However, there is a need to validate the use of AB-MRI in large groups and in various clinical settings. The BRAID trial experience identified practical issues regarding workflow integration, service implementation, and reporting protocols, that should be taken into account before a broad implementation in practice.[5]

Limitations: There are some limitations in the present study. First, the total number of respondents was relatively limited and this might restrict the extent to which the results can be generalised. Second, this study did not focus on an asymptomatic screening population, but rather symptomatic patients with suspected breast lesions which could affect diagnostic performance. Third, the shortened MRI protocol was tested on one MRI platform and findings could be different for various different MRI and imaging protocols. To confirm the clinical utility of AB-MRI, larger, long-term follow-up, multicentric studies are needed.

CONCLUSION

Abbreviated breast MRI is a novel and efficient imaging strategy that can be used for the assessment of breast lesions suspected during clinical evaluation and is shown to yield reliable diagnostic information that is similar to conventional full-protocol breast MRI, but considerably shorter in both acquisition and interpretation time. In the present study, the sensitivity, specificity and diagnostic accuracy of AB-MRI was 72.7%, 100%, and 90%, respectively, and on AB-MRI, characterization of lesions could be characterized using BI-RADS scoring. Even though sensitivity was relatively small in comparison because of the limited number of cases with lesions and the sample size of the cases, the results highlight the feasibility and potential impact of AB-MRI as time saving alternative to full breast MRI. In order to determine its applicability in consultations and routine diagnostic screening, more large scale multicentric studies are necessary.

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